

**** PUBLIC COMMENT DRAFT ****

**Total Maximum Daily Load (TMDL) Study
For Waterbodies in the Vicinity of the I-93 Corridor
from Massachusetts to Manchester, NH:**

Dinsmore Brook in Windham, NH

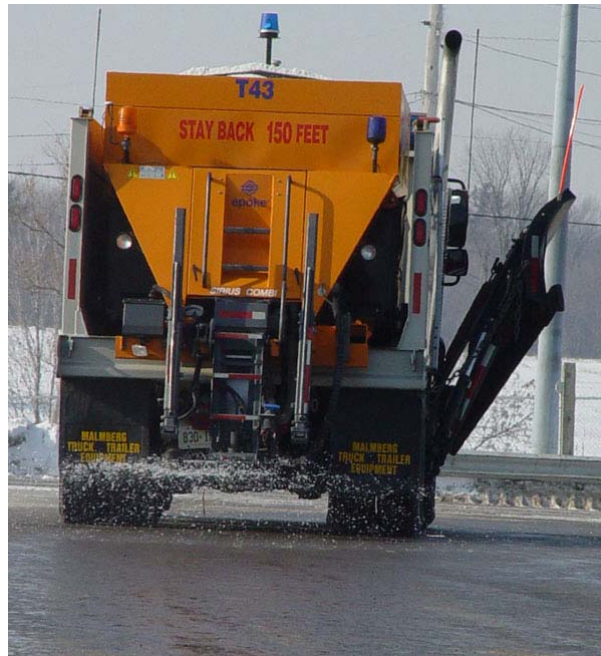


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December 2007



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**Total Maximum Daily Load (TMDL) Study
For Waterbodies in the Vicinity of the I-93 Corridor
from Massachusetts to Manchester, NH:**

Dinsmore Brook in Windham, NH

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1. Introduction

Section 303(d) of the Clean Water Act (CWA) and the Environmental Protection Agency's Water Quality Planning Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water quality limited segments that are not meeting designated uses under technology-based controls for pollution. The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollutant sources and instream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources.

The purpose of this study is to develop a TMDL for chloride in the Dinsmore Brook watershed located in Windham, N.H. The goal is to reduce chloride loads so that water quality standards for all the designated uses affected by chloride pollution are met in all areas of the Dinsmore Brook watershed.

2. Problem Statement

a. Waterbody Description

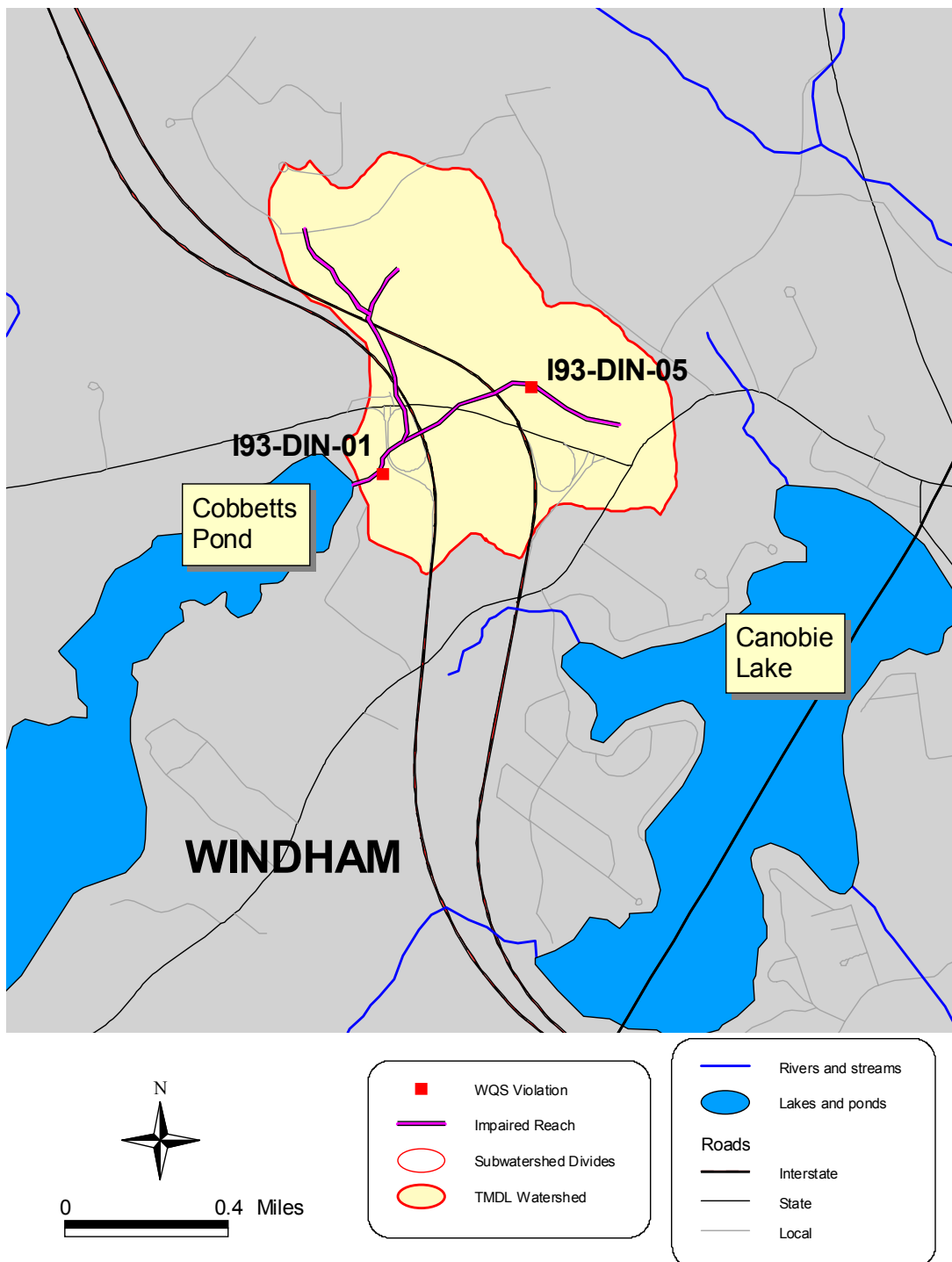
The assessment unit for this TMDL is Dinsmore Brook (NHRIV700061204-01). It is a stream segment of 1.5 miles located in Windham, N.H. The watershed for this assessment unit is 0.55 square miles (Figure 1). Land use characteristics of the watershed are listed in Table 1.

Table 1: Land use in the Dinsmore Brook watershed

Land Use and Demographics	Dinsmore Brook Watershed	Units
Agriculture	4.19	% of area
Cleared	10.53	% of area
Developed	6.68	% of area
Forested	60.64	% of area
Transportation	14.78	% of area
Wetland	3.18	% of area
Drainage Area	0.55	Square miles
Population	103	People
Housing Units	30	Number
Population Density	186	People/sq.mi.
"Urbanized Area" Classification	28.6%	% of area

Data Source: DES (2007b)

Figure 1: Impaired Assessment Units and Water Quality Violations in the Dinsmore Brook Watershed



b. Applicable Water Quality Standards and Water Quality Numeric Targets

Water Quality Standards determine the baseline water quality that all surface waters of the State must meet in order to protect their intended (designated) uses. They are the "yardstick" for identifying where water quality violations exist and for determining the effectiveness of regulatory pollution control and prevention programs. The standards are composed of three parts; designated uses, criteria, and antidegradation regulations.

In New Hampshire, all state surface waters are either classified as Class A or Class B, with the majority of waters being Class B. A general description of designated uses for each classification may be found in state statute RSA 485-A. According to New Hampshire's Consolidated Assessment and Listing Methodology (CALM; DES, 2005) designated uses for New Hampshire surface waters include those shown in Table 2.

The second major component of water quality standards is the "criteria." These are numeric or narrative criteria which define the water quality requirements for Class A or Class B waters. Criteria assigned to each classification are designed to protect the designated uses for each classification. A waterbody that meets the criteria for its assigned classification is considered to meet its intended use. Water quality criteria for each classification may be found in RSA 485-A:8, I-V [www.gencourt.state.nh.us/rsa/html/L/485-A/485-A-8.htm] and in the State of New Hampshire Surface Water Quality Regulations (Env-Ws 1700) [www.des.nh.gov/rules/env-ws1700.pdf]. The CALM (DES, 2005) describes the methodologies for comparing water quality data with the criteria to assess designated use support.

The third component of water quality standards are antidegradation provisions which are designed to preserve and protect the existing beneficial uses of the State's surface waters and to limit the degradation allowed in receiving waters. Antidegradation regulations are included in Part Env-Ws 1708 of the New Hampshire Surface Water Quality Regulations. Antidegradation is not a consideration for this TMDL study.

Dinsmore Brook is a Class B waterbody. According to Env-Ws 1703.21, the water quality criteria for chloride in nontidal Class B waterbodies to protect aquatic life is that concentrations should not exceed 860 mg/L for acute exposures or 230 mg/L for chronic exposures. Acute aquatic life criteria are based on an average concentration over a one-hour period and chronic criteria are based on an average concentration over a period of four days (EPA, 1991). The frequency of violations for either acute or chronic criteria should not be more than once every three years, on average (EPA, 1991).

Table 2: Designated Uses for New Hampshire Surface Waters

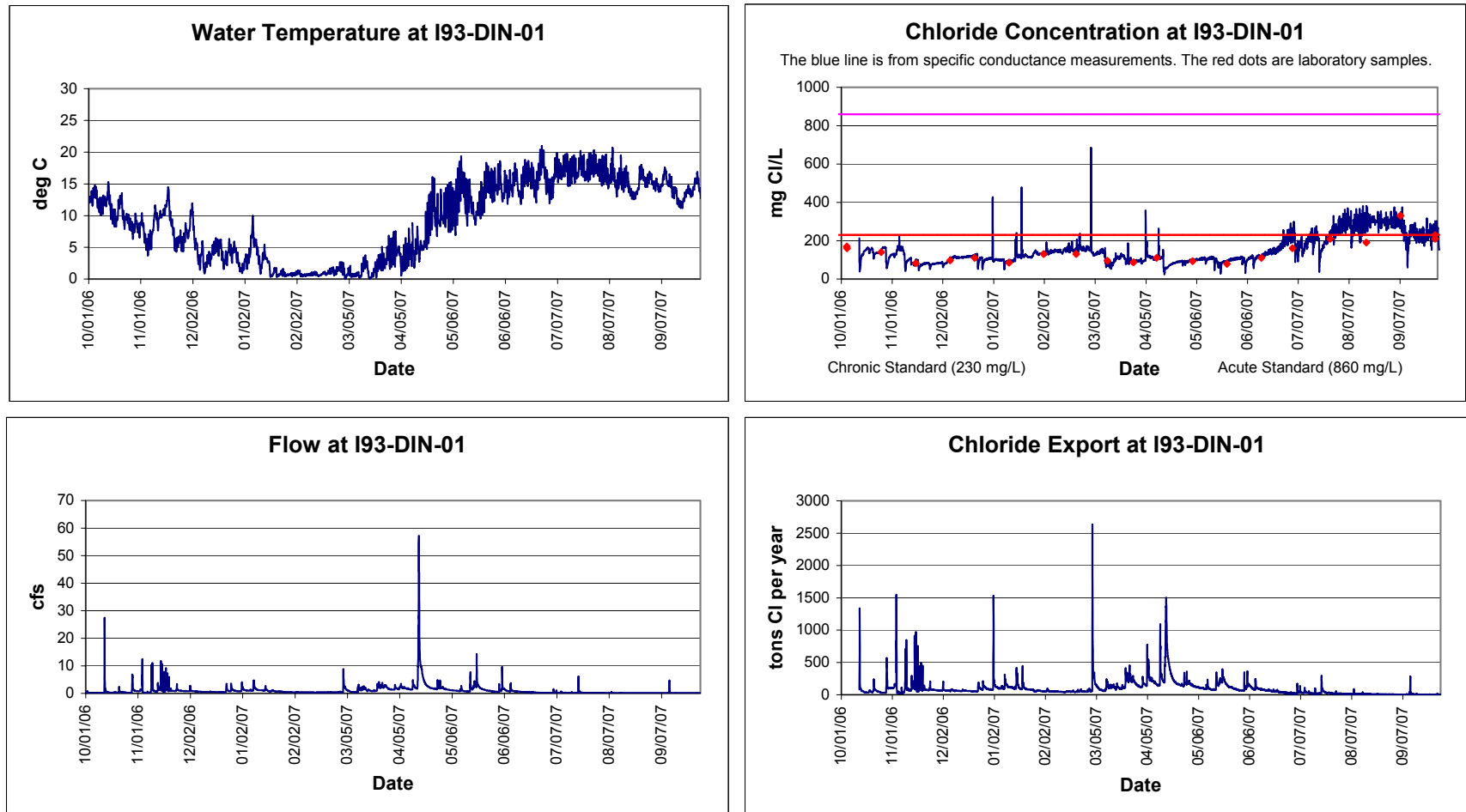
Designated Use	DES Definition	Applicability
Aquatic Life	Waters that provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms.	All surface waters
Fish Consumption	Waters that support fish free from contamination at levels that pose a human health risk to consumers.	All surface waters
Shellfish Consumption	Waters that support a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers	All tidal surface waters
Drinking Water Supply	Waters that with adequate treatment will be suitable for human intake and meet state/federal drinking water regulations.	All surface waters
Primary Contact Recreation (i.e. swimming)	Waters suitable for recreational uses that require or are likely to result in full body contact and/or incidental ingestion of water	All surface waters
Secondary Contact Recreation	Waters that support recreational uses that involve minor contact with the water.	All surface waters
Wildlife	Waters that provide suitable physical and chemical conditions in the water and the riparian corridor to support wildlife as well as aquatic life.	All surface waters

3. Dinsmore Brook Receiving Water Quality Characterization

In the winters ending in 2003, 2004, 2005 and 2006, the New Hampshire Department of Environmental Services (DES), the US Environmental Protection Agency (EPA), and the New Hampshire Department of Transportation (DOT) monitored chloride in watersheds in the vicinity of I-93 in southern New Hampshire. Chloride concentrations were primarily measured in winter with near continuous specific conductance readings by data loggers. DES placed the assessment unit NHRIV700061204-01 on New Hampshire's 2006 Section 303(d) list because measurements of chloride concentrations through 2005 demonstrated exceedences of State surface water quality standards. The assessment unit, along with all rivers and lakes in the state, is also listed as impaired for the fish consumption designated use due to the state-wide fish consumption advisory for mercury.

For this TMDL study, DES, EPA and DOT developed a monitoring program to collect a comprehensive and standardized dataset for chloride, stream flow, and chloride imports to and exports from the watershed (DES, 2006). The monitoring plan was implemented between July 1, 2006 and September 30, 2007. The data from this monitoring program have been summarized in a Data Quality Audit (DES 2007a) and a Data Report (DES 2007b). The difference between the TMDL monitoring and the previous efforts is that data were collected at the same time at all stations to allow comparison between stations under similar conditions. Stream flow data were collected so that chloride flow duration curves and export calculations could be made. Figure 2 shows the near continuous measurements of temperature, chloride, stream flow, and chloride export (product of chloride concentration and stream flow) at station I93-DIN-01 between October 1, 2006, and September 30, 2007. The average values for these parameters over the year were 9.12 °C, 148.95 mg Cl/L, 0.97 cfs, and 92.44 tons Cl/yr, respectively. For perspective, typical concentrations of chloride in New Hampshire rivers in 1920, before salt was used as a deicer, were 1.3 mg Cl/L (Hall, 1975).

Figure 2: Time Series of Temperature, Chloride, Stream Flow and Chloride Export at Station I93-DIN-01

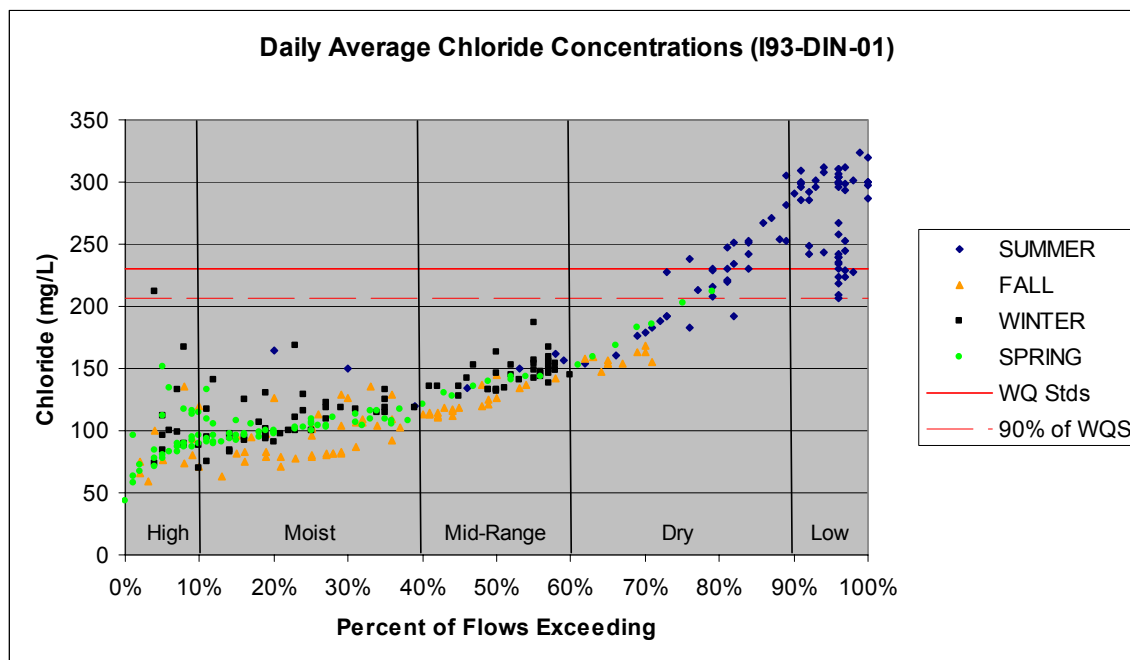


Data Source: DES (2007b)

The monitoring for the TMDL study detected violations of the chronic water quality standard. At station I93-DIN-01 (Figure 1) the water quality violated the chronic standard for 68.5 days of the year (18.8 percent). All of the locations in the watershed where violations of water quality standards have been detected are shown in Figure 1. The violations on this figure are from a compilation of all relevant data from 2002-2007 (DES, 2007b). The number of violations and the exact dates when these violations occurred are summarized in DES (2007b).

Concentration-flow duration curves were used to document how the chloride concentration changed with stream flow (DES, 2007b). For these plots, the measured stream flow on a date was converted to the percent of the time when that flow level is exceeded. The methods for the historical flow duration calculations are provided in DES (2007b). The concentration-flow duration plot for station I93-DIN-01 is shown in Figure 3. This figure indicates that the highest concentrations occur when stream flows are low (flow exceedence percentiles of 60-100 percent, “dry” or “low flow” conditions). Violations of the water quality standard occurred exclusively in the summer. However, concentration-flow duration plot indicates that that low stream flow is the critical condition for violations.

Figure 3: Concentration-Flow Duration Plot for Station I93-DIN-01



Data Source: DES (2007b)

4. Source Characterization

Chloride in the form of salt is imported to the study watersheds from several major sources: Roadway deicing, food waste, water softeners, atmospheric deposition, and roadway salt pile runoff. DES estimated the mass of salt imported from each source. Details on how these estimates were made are provided in DES (2007b). For the TMDL, groundwater was considered a pathway for chlorides, not an independent source.

All of the chloride imported to the watershed is eventually delivered to the impaired reach through stormwater runoff and groundwater flow. Stormwater flow through municipal storm sewer systems (MS4) covered by the Phase II stormwater program regulations will be considered a point source for this TMDL (EPA, 2002). The balance of the stormwater runoff will be considered a non-point source. Twenty nine percent of the watershed is covered by the MS4 Phase II program (Table 1); therefore, 29% of the chloride load will be considered a point source.

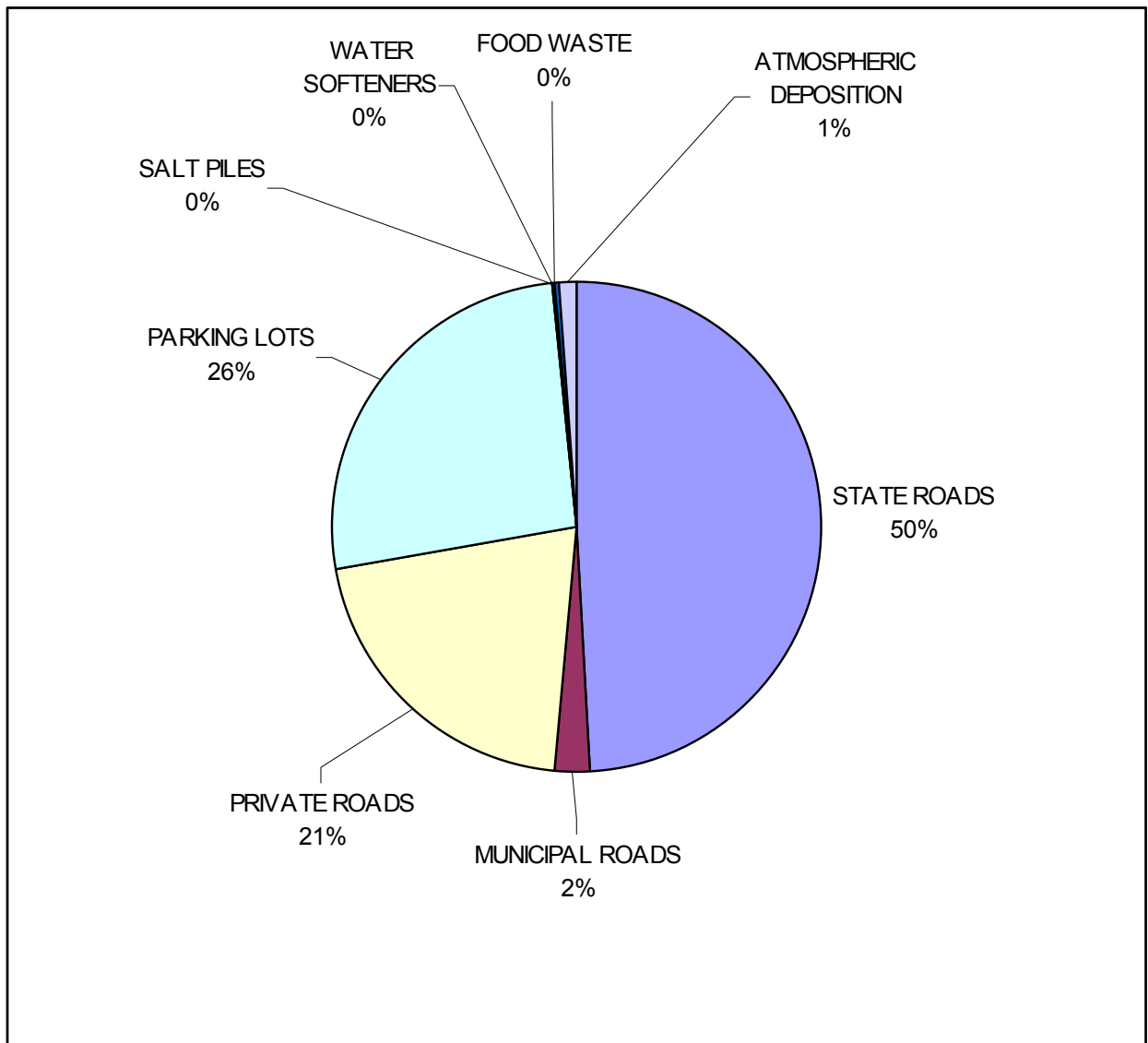
The salt imports for the period July 1, 2006 to June 30, 2007 are listed by source in Table 3. DES has assumed that the salt imports for this period would be the same for the October 1, 2006 to September 30, 2007 period (to match the water quality record). The only salt import source with a seasonal cycle is deicing and no deicing occurs during the summer months. A total of 166.5 tons of salt was imported to the watershed at an average rate of 301.3 tons of salt per square mile of drainage area. The contribution of each source to the total load is shown in Figure 4. Deicing of roadways and parking lots accounted for 98 percent of the imports, with state roads being the single largest source (49 percent). There were no salt piles in the watershed. Water softeners, food waste, and atmospheric deposition were minor components.

Table 3: Sources of Salt to the Dinsmore Brook Watershed

Source	Salt Imports (tons salt/yr)
State Roads	81.7
Municipal Roads	4.0
Private Roads	34.3
Parking Lots	43.4
Salt Piles	0.0
Water Softeners	0.7
Food Waste	0.5
Atmospheric Deposition	1.7
Total	166.5

Data Source: DES (2007b)

Figure 4: Relative Contribution of Each Source to the Total Salt Imports to the Watershed



Data Source: DES (2007b)

5. TMDL and Allocations

a. Definition of a TMDL

According to the 40 CFR Part 130.2, the total maximum daily load (TMDL) for a waterbody is equal to the sum of the individual loads from point sources (i.e., waste load allocations or WLAs), and load allocations (LAs) from nonpoint sources (including natural background conditions). Section 303(d) of the CWA also states that the TMDL must be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety (MOS), which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. In equation form, a TMDL may be expressed as follows:

$$TMDL = WLA + LA + MOS$$

where:

WLA = Waste Load Allocation (i.e. loadings from point sources)

LA = Load Allocation (i.e., loadings from nonpoint sources including natural background)

MOS = Margin of Safety

TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure (40 CFR, Part 130.2 (i)). The Dinsmore Brook TMDL will be expressed as a load duration curve following guidance from EPA (2007). The MOS can be either explicit or implicit. If an explicit MOS is used, a portion of the total allowable loading is actually allocated to the MOS. If the MOS is implicit, a specific value is not assigned to the MOS. Use of an implicit MOS is appropriate when assumptions used to develop the TMDL are believed to be so conservative that they are sufficient to account for the MOS.

b. Determination of TMDL

i. Seasonal Considerations/Critical Conditions

Section 303(d) of the CWA states that the TMDL must be established at a level necessary to attain the applicable water quality standards with seasonal variations. In Table 4, the factors which can influence chloride concentrations have been listed, along with how those factors will be manipulated to ensure that the TMDL will result in attainment of water quality standards during critical conditions.

Table 4: Factors for Determining Critical Conditions

Factor	Effect on Chloride Concentration	Selection of Critical Condition
Season	Figure 3 shows that most violations occurred during the summer season during a period of low stream flow.	The TMDL will be expressed as a load duration curve to set limits for low flow periods during the summer season.
Stream Flow	Figure 3 shows that chloride concentrations increase as stream flows decrease. The critical hydrologic condition is 60-100 percent flow exceedences (“dry” or “low flow” conditions).	The TMDL will be expressed as a load duration curve to accurately describe the acceptable load at each stream flow.
Location	The proximity of salt sources can affect the chloride concentration in the waterbody.	Data from the year round station with the most violations of the water quality standard will be the basis for the TMDL.
Water Quality Standard	Either the acute or chronic water quality standard must be chosen to set the target for the TMDL.	The chronic standard will be the basis for the TMDL target because most of the violations in the watershed were of the chronic standard. The chronic standard is also lower than the acute standard.

ii. Margin of Safety

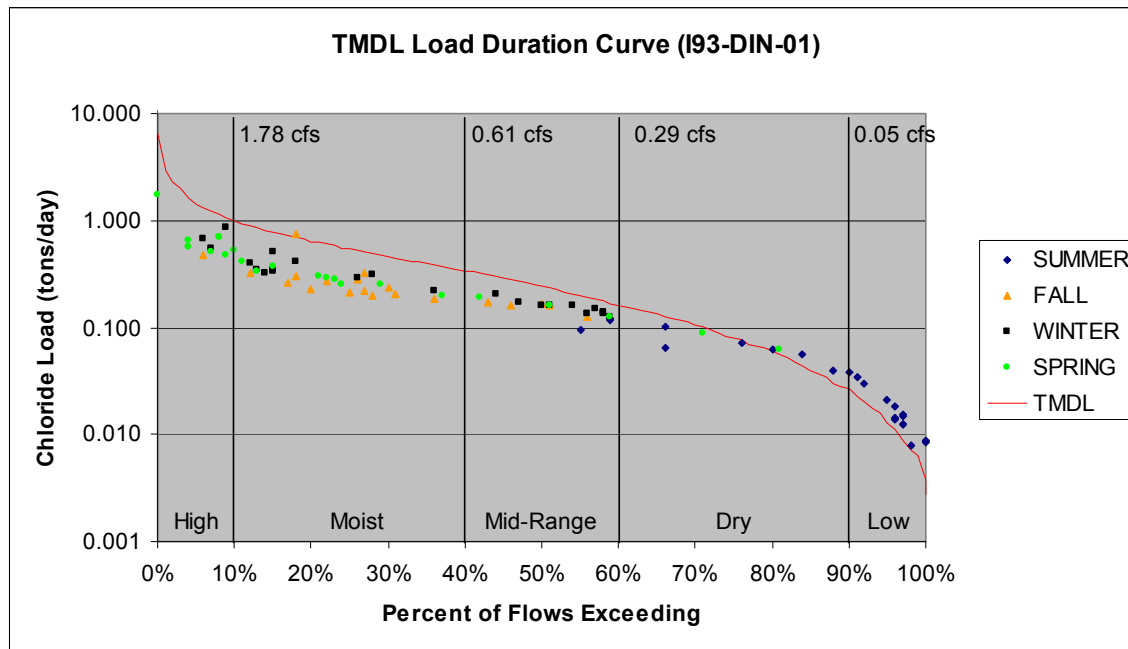
An explicit Margin of Safety (MOS) will be used in the TMDL calculation. The TMDL will be set at 90 percent of the chronic water quality standard ($90\% \times 230 \text{ mg Cl/L} = 207 \text{ mg Cl/L}$). This assumption is equivalent to holding 10 percent of the loading in reserve to account for scientific uncertainty.

iii. TMDL Calculation

The TMDL will be expressed as a load duration curve following guidance from EPA (2007) and in compliance with the approved Quality Assurance Project Plan (DES, 2006). The TMDL will be 90 percent of the chronic water quality standard (207 mg Cl/L) multiplied by each stream flow in the four day average flow duration curve. The four-day average flow duration curve was used because the chronic water quality standard applies to four day average concentrations. The TMDL will be set for the outlet station of the watershed, I93-DIN-01, because the watershed is small. Figure 5 shows the TMDL load duration curve and the existing loads measured at I93-DIN-01 between October 1, 2006 and September 30, 2007. The units for the TMDL are tons of chloride per day. At each point on the TMDL curve, the waste load allocation for MS4 permittees is 28.6 percent of the TMDL and the load allocation for non-point sources is 71.4 percent of the TMDL (not shown on figure). The margin of safety is explicit. The TMDL load duration curve

is not expected to change; therefore, this TMDL is relevant to all existing and future impairments due to chloride in the Dinsmore Brook watershed.

Figure 5: TMDL Load Duration Curve at Station I93-DIN-01



The TMDL can be alternatively expressed as a percent reduction goal (PRG) to guide implementation. The method for calculating the PRG was described in the approved Quality Assurance Project Plan (DES, 2006). In summary, each individual chloride export value was compared to the TMDL. If the value was higher than the TMDL, the percent by which this value would need to be reduced to reach the TMDL was calculated. All of the individual PRGs calculated for the “dry” hydrologic condition were grouped and the 90th percentile value calculated (DES, 2007b). Even though many water quality violations occurred in the “low flow” hydrologic condition, the “dry” condition was chosen for this calculation following guidance in EPA (2007). Low flow conditions are extreme events which are not representative of typical conditions; reliable data from these extreme events are difficult to obtain. The four day averaging period was used for this calculation to be consistent with the chronic water quality standard and the TMDL load duration curve. For the Dinsmore Brook watershed, the PRG was determined to be 24.3 percent for the October 1, 2006 to September 30, 2007 period. The total salt imports to the watershed during this period were 166.5 tons of salt per year. Therefore, salt imports to the watershed should be less than 126.0 tons of salt per year in order to attain water quality standards.

iv. Allocation of Loads

In 2006, DOT and DES established an interagency Salt Reduction Workgroup. The purpose of the workgroup is to advise DES and DOT on the TMDL study and implementation plan until these are complete, and to advise and then to assist with implementation of required salt load reductions. The workgroup includes representatives from: DES, DOT, EPA, the Federal Highway Administration (FHWA), the selectmen's office of each town with area in a TMDL watershed, the public works department of each town with area in a TMDL watershed, the University of New Hampshire T2 Program, private winter road and parking lot maintenance companies, motorist associations, the State Police, the Southern New Hampshire Regional Planning Commission, the Nashua Regional Planning Commission, and the Rockingham Planning Commission.

In 2008, the Salt Reduction Workgroup will determine the final load allocations by sector. However, as a starting point, draft allocations are presented in Table 5 based on the following assumptions:

- Ninety-eight percent of the salt imports to the watershed were from deicing activities. Therefore, essentially all of the salt import reductions will need to come from reduced deicing loads. The percent reduction in salt imports will be the same for state, municipal, and private roads and parking lots.
- The allocation for salt pile runoff will be zero because there were no salt piles in the watershed and any new salt and salt-sand piles should be covered.
- The existing loads from water softeners, food waste, and atmospheric deposition will be used as the allocation for these sources.

Table 5: Existing Salt Imports and Load Allocations

Source	FY07 Salt Imports (tons salt/yr)	Allocation of Loads (tons salt/yr)	Percent Reduction
State Roads	81.7	61.5 (10.3 tons/lm/yr)	24.7%
Municipal Roads	4.0	3.0 (3.1 tons/lm/yr)	24.7%
Private Roads	34.3	25.8 (6.2 tons/lm/yr)	24.7%
Parking Lots	43.4	32.7 (4.8 tons/ac/yr)	24.7%
Salt Piles	0.0	0.0	0%
Water Softeners	0.7	0.7	0%
Food Waste	0.5	0.5	0%
Atmospheric Deposition	1.7	1.7	0%
Total	166.5	126.0	24.3%

In the preceding table, the deicing load allocations were expressed in units of both tons per year and tons per lane-mile (or acre) per year. The latter values were calculated from the total lane miles or parking lot acres managed by each organization in 2007.

6. Implementation Plan

a. Statutory/Regulatory Requirements

Section 303(d)(1)(C) of the CWA provides that TMDLs must be established at a level necessary to implement the applicable water quality standard. The following is a description of activities that are planned to abate water quality concerns in the Dinsmore Brook watershed.

b. Description of Activities to Achieve the TMDL

i. Implementation Plan

To implement this TMDL, salt imports to the watershed for deicing must be limited to the allocated loads in Table 5. State law (RSA 485-A:12.II) provides that “If, after adoption of a classification of any stream, lake, pond, or tidal water, or section of such water, including those classified by RSA 485-A:11, it is found that there is a source or sources of pollution which lower the quality of the waters in question below the minimum requirements of the classification so established, the person or persons responsible for the discharging of such pollution shall be required to abate such pollution within a time to be fixed by the department.”

The details of an implementation plan will be developed by the Salt Reduction Workgroup in 2008 (see section 5(b)(iv) for information on the workgroup). The plan will require that owners of property on which salt is applied track and report the amount applied. This will be compared with allocations on an annual basis to determine compliance with RSA 485-A:12 and the load allocations of Table 5. It should be noted that the load allocations in the TMDL do not include an allowance for future growth, so any future construction of additional roads or parking lots in the TMDL watersheds would necessitate additional load reductions elsewhere in the watershed beyond the allocations in Table 5.

ii. Monitoring

Pending the availability of resources, specific conductance will be monitored at 15 minute intervals with data loggers at the outlet station for the watershed, I93-DIN-01, from December 1 to March 31 every year through March 31, 2016. Stream flow will be estimated using regression relationships with the USGS Beaver Brook gage. The data will be analyzed for violations of the acute and chronic water quality standards and percent reduction for critical conditions following the procedures used in this report. The number of violations, the percent reduction goals during the critical conditions, and the salt imports to the watershed will be tracked for each year. NHDES will evaluate changes in these values using multivariate linear or logistic regression with climate variables (e.g., the DOT Winter Severity Index, flow) as covariates. A trend will be considered significant if the coefficient of the year term in the equation is significant at the $p < 0.05$

level. A minimum of five years of data (and most likely 10 years) will be needed before trend analysis can be performed.

7. Public Participation

a. Description of the Public Participation Process

EPA regulations (40 CFR 130.7 (c) (ii)) require that calculations to establish TMDLs be subject to public review.

To be completed after the public comment period has ended.

b. Public Comment and DES Response

To be completed after the public comment period has ended.

8. References

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